Amendments to the Specification:

Please replace the Specification of the present application, including the Abstract, with the following Substitute Specification. A marked-up version of the Substitute Specification and Abstract is attached hereto.

SPECIFICATION

TITLE OF THE INVENTION

ERROR PROCESSING OF USER INFORMATION RECEIVED BY A COMMUNICATION NETWORK

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a method and a system for error correction of user information received via a communication network.

[0002] Document D1 U.S. Patent No. 5,699,405 describes how data and voice signals of a communications information signal of a cellular radio telephone are decoded simultaneously by two decoders. A data signal of the information signal is decoded by a data decoder, and then a data signal sensor decides whether the decoded signal is a normal data signal. Only a normal signal is forwarded to a signal converter for executing a code conversion. The resultant signal is output by a transmitter circuit. A voice signal of the information signal is decoded by a voice decoder, and then a voice signal sensor decides whether the decoded signal is a normal voice signal. Only a normal signal is sent to a digital/analog converter for transforming into an analog voice signal. The validity of the decoded signals is verified, for example, by varying the frequency band and/or the amplitude of the decoded signals. Due to the simultaneous decoder operations, the data and the voice signals are decoded efficiently at high speed by one modem card. As such, there is one modem card for a cellular radio telephone for simultaneous transmission of data signals and voice signals to an information terminal, where an information terminal may be a computer.

[0003] In cellular text telephony, a cascade of a cellular radio receiver (e.g., GSM modem) and a CTM receiver (Cellular Text telephone Modem) is provided for received texts. An example of this is the U.S. American text telephony standard (see 3GPP TS 26.226) wherein text is first converted into audio signals by digital coding of an alphabet, channel coding and frequency modulation, and then the audio signals are processed further in the same way as normal speech by cellular radio terminals (cellular radio modems) and transmitted via a cellular radio channel. In order to guarantee the reliable transmission of emergency calls,

maximum error rates are specified for the transmission of the individual letters (see 3GPP TS 26.231). A CTM receiver and a cellular radio receiver are not highly compatible, however, and the complete system (cellular radio + CTM) cannot achieve sufficiently good performance, particularly in the sense of transmission efficiency, for the following reasons:

[0004] - A cellular radio voice coder/decoder (such as the AMR) in cellular radio is optimized for coding/decoding of human speech. For the artificially generated (CTM) audio signals, the voice coder/decoder is not efficient.

[0005] Under poor channel conditions, the error concealment, which is optimized for the human ear, is no longer satisfactory for the transmission of text information.

[0006] Accordingly, the present invention is directed toward a method and a device in a communication network that will better satisfy requirements in the transmission of data containing user information.

SUMMARY OF THE INVENTION

[0007] Pursuant to the present invention, the transmission characteristic of the voice channel, in combination with additionally conveyed data on the data rate of the voice coder and the channel quality determined in the channel decoder, is converted in the CTM receiver into a reliability measure. This reliability measure is used in the error correction of the received data in the CTM receiver in order to reconstruct the transmit signal with as few errors as possible. During the decoding of the voice-channel signal, particularly in the AMR voice decoder, there is also the option to disable voice-synthesis mechanisms that are optimized for the human ear and have a detrimental effect on the transmission of audio signals (error concealment). As such, the information in the CTM receiver that a CTM-text audio signal is being transmitted, is conveyed to the voice decoder so as to optimize the voice synthesis for user information (CTM-text audio signal) and not for human speech. A piece of user information is the information that is inserted into the stream of data at the transmitter end, and re-extracted from the data at the receiver end, such as text, voice signals, image signals, video signals etc., where the data is the received signals that are coded in a typical way for the transmission.

[0008] Some pieces of additional information are exchanged between the CTM receiver and the communication terminal receiver, for instance a cellular radio terminal, fixed network terminal, etc., primarily the BFI and AMR-mode parameters from the communication terminal receiver, and the CTM-signal indicator from the CTM text receiver. The performance of the overall system is improved substantially thereby. Since the inventive method only relates to the receiver end, the standard is unaffected.

[0009] The additional information that the CTM receiver receives can be used selectively to compensate for the disadvantages described for the transmission of data containing user information via voice coders. According to the present invention, the voice decoder can suppress error-concealment mechanisms when information is present that data containing user information is being transmitted. The transmission efficiency is thereby increased significantly, and the stipulated maximum error rates can be met, which, for instance, is a precondition for the sale of cellular radio equipment in the U.S.A.

[0010] Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description of the Invention and the Figures.

BRIEF DESCRIPTION OF THE FIGURES

[0011] Figure 1 shows a simplified representation of the suppression of the error concealment in the voice decoding and error correction with the aid of the additional information relating to the data to be transmitted.

DETAILED DESCRIPTION OF THE INVENTION

[0012] Figure 1 shows how the AMR channel decoder 1 receives the transmitted data from the equalizer in the form of TDMA bursts, and corrects channel errors as far as possible. The AMR channel decoder identifies from a checksum (CRC) whether the channel-decoded AMR voice frame is usable or unusable (in the sense of containing too many errors as a result of the transmission).

[0013] The AMR channel decoder 1 passes to the AMR voice decoder 2 the decoded voice frame, the AMR mode and the additional information as to whether the frame is usable. The latter piece of information is contained in the

RX_FRAME_TYPE parameter (BFI = Bad Frame Indicator). The AMR voice decoder 2 uses the BFI so as not to convert unusable frames into voice (audio signal) but, in this case, to synthesize the audio signal from frames from the past in such a way that the human ear only perceives a minimum interference (error concealment). This mechanism can be disabled if it is signaled via the CTM text/voice indicator that data (CTM signal) containing user information is being transmitted. At the output of the module is a PCM signal (Pulse Code Modulation). The BFI can be transmitted in unused bits (LSB) of the PCM signal. An advantage here is that one can implement the exchange of the additional information using the existing hardware.

[0014] The CTM receiver 6 includes, amongst other components, a demodulator unit 3 and an error correction module 4. In the former, two bits are generated from 40 PCM signal values, such bits being included in frequency modulated form in the PCM signal. The bits contain reliability information ("soft values") that indicates the likelihood of the decoded data matching the originally transmitted data. The reliability information is erroneously high for CTM-text user data if the 40 signal values originate from an AMR frame that has actually been received as unusable. This is because, due to error concealment, the signal has few acoustic interference components, but the frequency modulated information is taken from a voice frame of the past and, thus, cannot be used at the present moment in time. The demodulator 3, however, receives from the AMR channel decoder 1 the AMR-mode and RX Frame Type (in this case, the BFI) information. This is used in the calculation of the reliability information, and the transmission efficiency is increased.

[0015] In the CTM receiver 6, the demodulated CTM-text bits are scanned for a synchronization sequence, which is a sequence of specific frequencies indicating that a CTM text follows. If this sequence is detected, the CTM text/voice indicator is set to the value "CTM text" and forwarded to the AMR voice decoder 2, so that the error concealment is suppressed. At the end of the CTM-text user-data transmission, which is signaled with IDLE characters by the transmitter,

the indicator is re-set to the value "voice," and the error concealment can be re-enabled.

[0016] Although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the present invention as set forth in the hereafter appended claims.